SCIENCE 8

MODULE 5:

Growing Plants

Distance Learning

Alberta EDUCATION

Science 8

Module 5

GROWING PLANTS

Alberta
EDUCATION

Science 8
Student Module
Module 5
Growing Plants
Alberta Distance Learning Centre
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Welcome to Module 5!

We hope you'll enjoy your study of Growing Plants.

To make your learning a bit easier, a teacher will help guide you through the material.

So whenever you see this icon,

turn on your audiocassette and listen.

Contents

SECTION 3:

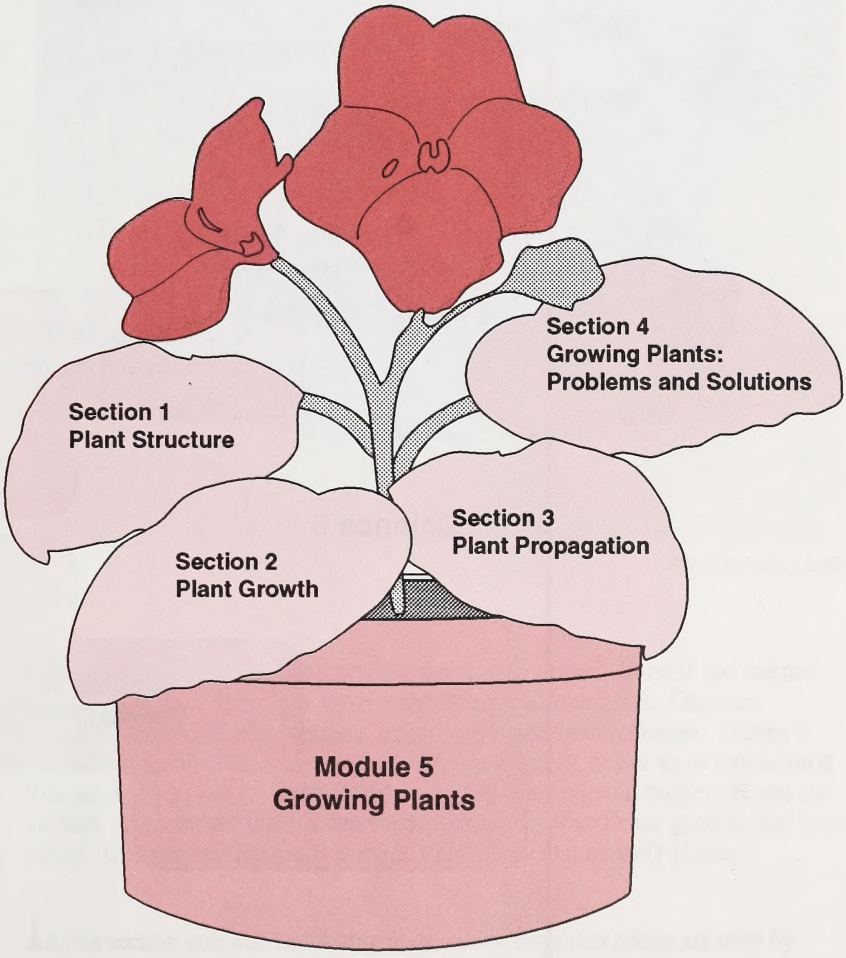
SECTION 4:

OVERVIEW

Can you imagine life without plants? There wouldn't be any forests, lawns, meadows, or flowers.

That's right, things would look very different and would be very different. You would not have any fruits or vegetables to eat or any of the animals that depend on plants for survival. In fact, life would not be possible.

In this module you will learn about plants: how they grow, what they need to grow, and how they reproduce. You will also experiment with growing plants under new conditions.

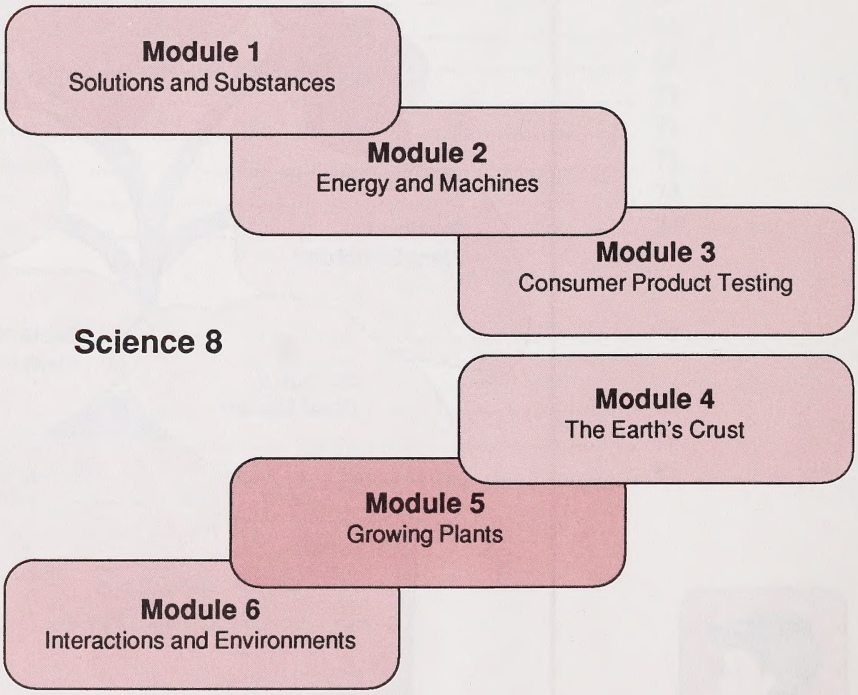


Evaluation

Your mark in this module will be determined by your work in the Assignment Booklet. You must complete all assignments. In this module you are expected to complete four section assignments.

The assignment breakdown is as follows:

Section 1 Assignment	**25%**
Section 2 Assignment	**25%**
Section 3 Assignment	**25%**
Section 4 Assignment	**25%**
TOTAL	**100%**



Section

1

Plant Structure

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There are very few people who have never seen a plant. Even if you are not able to leave your home, you have probably seen a houseplant. On your hamburger you may have ketchup, which was made from tomatoes. Maybe it had mustard, made from the seeds of the mustard plant, or leaves of lettuce on it. You might be a person who likes onions or tomatoes on your burger. If you ate the bun, you had the seeds of the wheat plant which were dried, ground, and then baked. Even the hamburger was made from a cow that ate only plants.

In this section you will be looking at the many ways that plants are used by people. You will also be learning about what plants need to survive, how plants are alike, and what the parts of plants are called.

Activity 1: Plants Are Everywhere

Plants are everywhere. No matter where you are, you will find that you are surrounded by things that are made from plants.

1. In the chart provided, list several items you have for breakfast or supper. You may have had bread, jam, peanut butter, eggs, ham, sausages, cereal, and milk for breakfast. For supper you may have had potatoes, beans, meat patties, and tea.

   To the right of each entry indicate the animal or plant source. In the third column show the diet for each of the animals listed.

   Some examples are given.

Food Item	Animal or Plant Source	Animal Diet
eggs	chickens	wheat, barley, corn
bread	wheat	

2. Describe a plant that is visible from your window.

Do either question 3 or question 4.

3. List the use of plant materials in the home. For example, what are wood, paper, and cloth used for? (If a surface like a wall or floor is covered by carpet or paint, you may have to ask someone what it is made of.)

4. Go to your clothes drawer or closet and look at the tags in your clothes. Are any of these clothes made of cotton, linen, or rayon? Which type of clothes contain these materials?

Check your answers with your learning facilitator.

You should now agree that plants provide much of the material for your food, your clothing, and your shelter.

Activity 2: Describing Plants

Plants are among the oldest living things on this planet. In fact the largest living thing ever is a plant. The giant sequoias weigh more than the largest dinosaur or the largest whale. One of the oldest living organisms in the world today is a bristlecone pine in Nevada, USA. It is over 4500 years old.

Plants come in many shapes and sizes. You will be looking at some structures that plants have in common and some structures that are different.

Bristlecone Pine

Giant Sequoias

1. Using what you already know, think about (brainstorm) all the words that describe plant structures, eg. leaf, stem, and bud. List these words.

_____

_____

_____

2. Now make a drawing of a tree and a dandelion plant. Draw them so that they show the parts of the plant listed in question 1.

3. Which words did you use for both plants?

_____

_____

_____

4. Can you think of a plant that does not have these parts?

_____

Check your answers with your learning facilitator.

Activity 3: The Plant Beneath the Surface

1. What root vegetables have you eaten?

_____

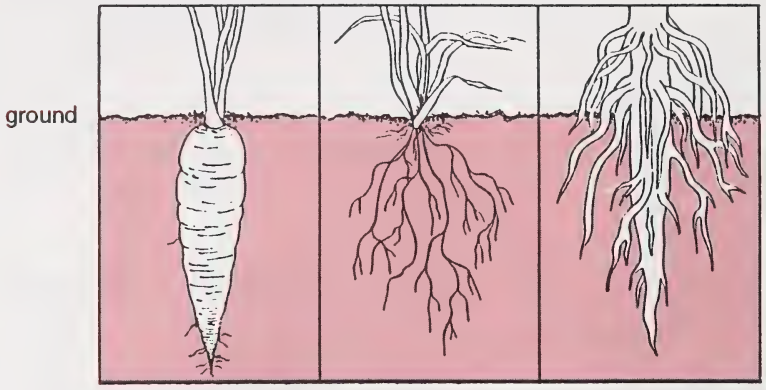
_____

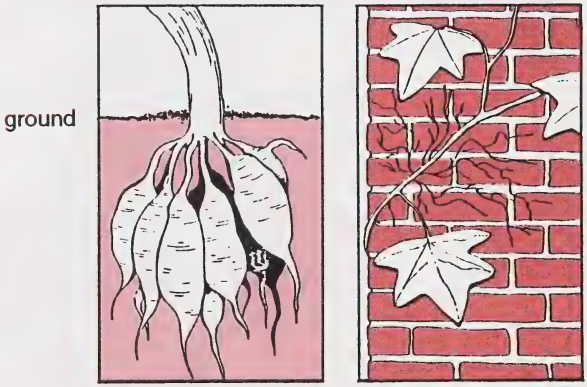
_____

Root: the part of the plant that grows down, usually underground

One part of the plant that often stays hidden is the **root**. It has several purposes; one is to anchor the plant, usually to the ground, and the other is to absorb water and nutrients. Roots are also used to store food the plant has made. For some plants, roots hold onto something when the plant climbs.

Many vegetables are the roots of plants and are the only edible part of the plant.





2. The previous illustration shows five root types. Which ones do you suppose would be edible?

_____

3. Look at your answers for question 1. What type of root do you think the ones you ate were?

_____

_____

4. Go outside and find a small plant (no higher than knee-high). Check with your learning facilitator that you are not digging out anything that shouldn't be dug out. With a spade, dig it out carefully. Carefully remove the loose dirt. In a bucket of water rinse off all the remaining dirt from the root. Identify the type of root it is. Make a diagram of the root. If you have done this quickly, you can replant the plant right away. If you cannot obtain a plant from outside, you may inspect the roots of a potted plant.

   Root Type: _____

5. You can think of the various roots as structural adaptations. For each of the root types, tell what you think its special advantage is.

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

Check your answers with your learning facilitator.

Activity 4: Parts of the Flower

It is the day of the wedding. The bride appears and all the people notice two things. She is wearing a beautiful dress and she carries a lovely bouquet of flowers. That is right, flowers are a big part of life. You have them at weddings, give them when someone is sick, and even have them when people die. Flowers are of great significance for many societies.

Photo courtesy of Don Klein.

1. Can you think of an occasion when someone in your family gave, or was given, flowers? What kind of flowers were they?

   _____

   _____

Flowers are also very important to the plants themselves. They contain the reproductive structures of the plant, and they lure birds and insects that will help the plant reproduce.

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Sepal: one of the leaves that form the outer covering of the flower

Petal: one of the coloured parts of the flower

Stamen: the male part of the flower

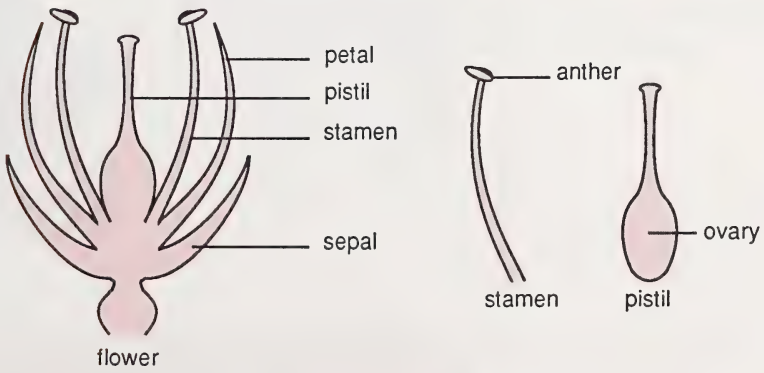
Anther: the tip of the stamen It produces pollen.

Pollen: the fine, yellowish powder at the top of the stamen It contains the male genetic material in many plants.

Pistil: the female part of the flower It contains the ovary.

Ovary: the enlarged part of the pistil It contains the female genetic material in all plants.

Most flowers have four parts. **Sepals** are on the outside and are most visible when the flower is closed. They are green. **Petals** are the parts most visible when the flower is open. They come in many beautiful colours and are usually not green. **Stamens** are even closer to the centre of the flower. The stamen contains the male part of the flower. On top of the stamen is a little sac called the **anther**. This produces the **pollen**. **Pistils** are found in the centre of the flower. There might be one or several. On the bottom of the pistil there is the **ovary**. This becomes the fruit with one or more seeds in it.



8
Science Directions

Read page 255 in your textbook to learn more about flowers.

Do either question 2 or question 3.

If you have broccoli, do question 2.

2. Have a look at a broccoli stalk. The green bumps on top are the closed flowers (buds) of the broccoli plant. Very carefully pluck one of the biggest ones off and name and count the parts of the flower. Hint: Use tweezers and if the buds are too small put the broccoli into a vase of water for a day.

_____

_____

_____

_____

3. Name and count the parts of any other flower that is available. For example, roses, tulips, or lilacs may be used.

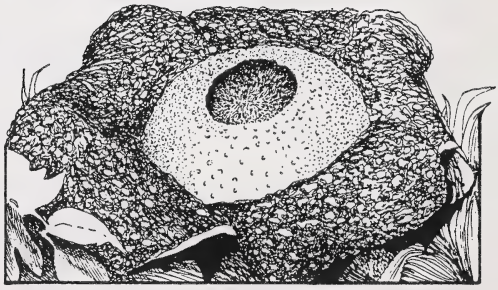
_____

_____

_____

_____

Flowers can be so small that they are almost invisible, or they can be huge. The largest flower is that of the rafflesia. It can weigh more than 10 kg and be more than 1 m across.



Rafflesia

Check your answers with your learning facilitator.

Activity 5: Climate and Soil

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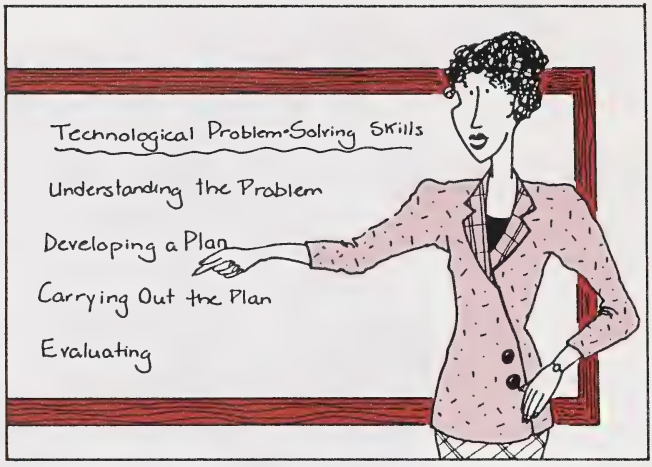
Growing plants is one of Alberta's largest industries. Plants require soil, water, sunlight, warmth, and nutrition to be able to grow. In order to survive, farmers need to make decisions based on crop prices and the presence of water, warmth, sunlight, and nutrition. The type of soil is also very important because it could hold too much water or too little water. It may have not enough nutrients, too many minerals, or it may be too hard to allow sprouting.

1. You also make decisions. Think back to the last time you left the house for a few hours. Write how the climate influenced your choice of clothing, transportation, and activity.

In this module you will be using a technological problem-solving model which you have used before.



In question 1 you wrote how climate affected the way you might dress. Following are several sentences that relate to such a situation.

Nancy really wanted to visit her friend Sue. She wondered what she should wear in the cold and the rain. Sue did not live that far away. Nancy decided to wear her jeans and blouse but to take an umbrella. It sure was cold out there. She went over to Sue's house. When Nancy arrived at her friend's house, she was dry but freezing cold.

2. Pick out four sentences and match each of them with one of the four problem-solving steps.

   a. Which sentence has to do with understanding the problem?

   _____

   _____

   b. Which sentence shows developing a plan?

   _____

   _____

c. Which sentence relates to carrying out the plan?

_____

_____

d. Which sentence relates to evaluating?

_____

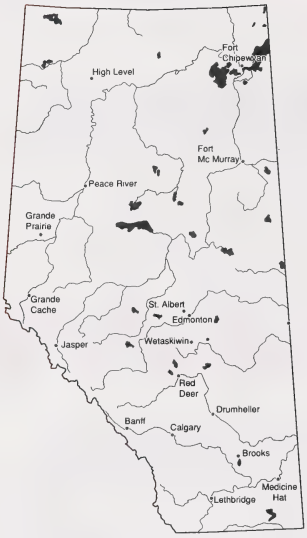
_____

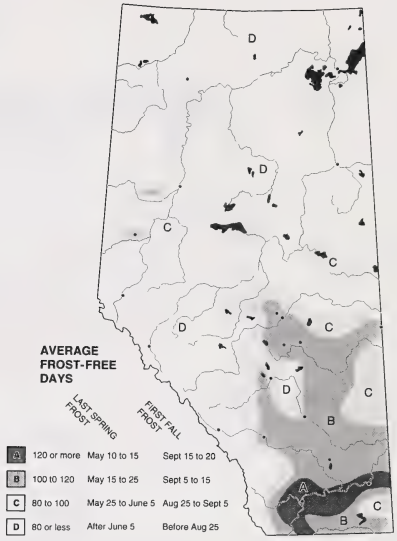
Check your answers with your learning facilitator.

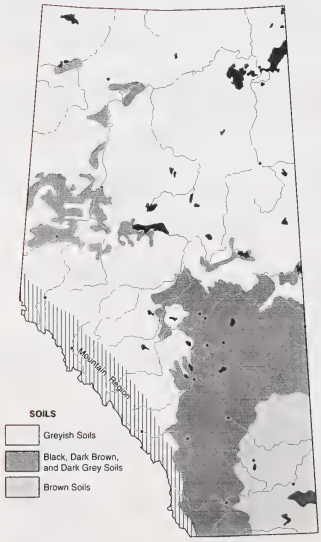
The technological problem-solving model is useful in agriculture. Look at the maps of Alberta and find where you live. Pretend that you are a farmer who has to decide which crop to plant for next year. To develop your plan you may only use these facts and the maps.

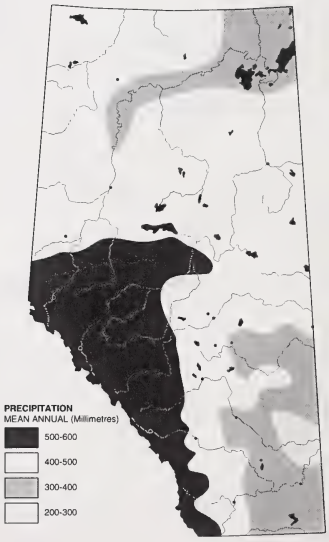
- Wheat does not grow well in grayish soils and needs more frost-free days than other crops.
- Rye grows well in more water than wheat. It grows better in black, dark brown, and dark grey soils.
- Barley does well in black, dark brown, and dark grey soils, and it can tolerate more rain.
- Canola grows well in most soils, but it requires between 350 to 450 mm mean (average) annual rainfall.
- Flax can withstand more frost-free days than canola.
- Prices per tonne:

Flax	$316.00
Canola	$346.00
Rye	$98.00
Barley	$105.00
Wheat	$170.00


Fort Chipewyan
High Level
Fort Mc Murray
Peace River
Grande Prairie
Grande Cache
St. Albert
Edmonton
Jasper
Wetaskiwin
Red Deer
Drumheller
Banff
Calgary
Brooks
Medicine Hat
Lethbridge


AVERAGE FROST-FREE DAYS
LAST SPRING FROST
FIRST FALL FROST
A 120 or more May 10 to 15 Sept 15 to 20
B 100 to 120 May 15 to 25 Sept 5 to 15
C 80 to 100 May 25 to June 5 Aug 25 to Sept 5
D 80 or less After June 5 Before Aug 25


Mountain Region
SOILS
Greyish Soils
Black, Dark Brown, and Dark Grey Soils
Brown Soils


PRECIPITATION
MEAN ANNUAL (Millimetres)
500-600
400-500
300-400
200-300

3. Apply the technological problem-solving model in your role as a farmer deciding on a crop.

Step One: Understanding the Problem

a. What problem do you have to solve as a farmer?

_____

_____

Step Two: Developing a Plan

b. What is your plan? Support your plan with reasons.

_____

_____

_____

_____

_____

_____

Step Three: Carrying Out the Plan

c. What is involved in carrying out the plan?

_____

_____

Step Four: Evaluating

d. How would you determine whether your problem was solved effectively?

_____

_____

Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

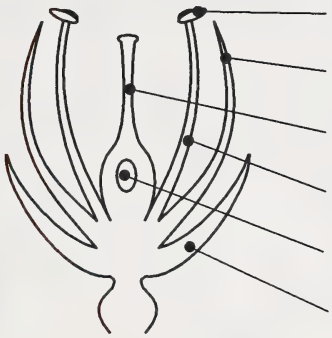
Extra Help

Here is a review of the basic ideas in this section.

- Plants are everywhere. All life on Earth is based on plants. Every animal eats either plants or it eats another animal which eats plants.
- There is a very large variety of plants. Many of them have these parts in common: roots, stems, leaves, flowers, fruits, seeds, leaf buds, and flower buds.
- Roots serve to hold the plant in the ground and to take up water and nutrients. There are several types of roots: tap roots, fibrous roots, prop roots, storage roots, and aerial roots.
- Flowers come in many shapes and sizes. Many of them have four parts: sepals, petals, stamens, and pistils. The stamen has an anther on top and the pistil has an ovary at the bottom. The petals attract pollinators, and the stamen and the pistil are the reproductive structures.
- Climate and soil influence the growth of plants. The amount of rainfall, sunlight, and heat affects plant growth. The type of soil also has an effect on plant growth.
- The technological problem-solving model has four steps: understanding the problem, developing a plan, carrying out the plan, and evaluating the plan.

1. Label the diagram of the plant with the correct terms.

2. Label the diagram of the flower using the correct terms.



3. Why are plants important to all other living things?

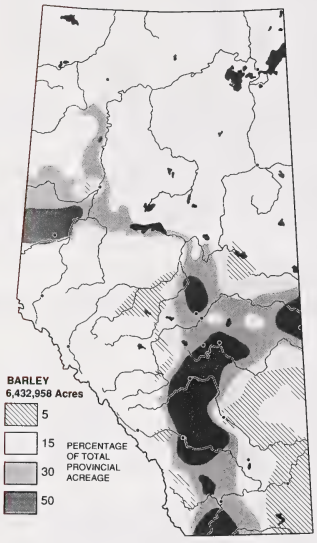
4. Name the two important factors influencing plant growth.

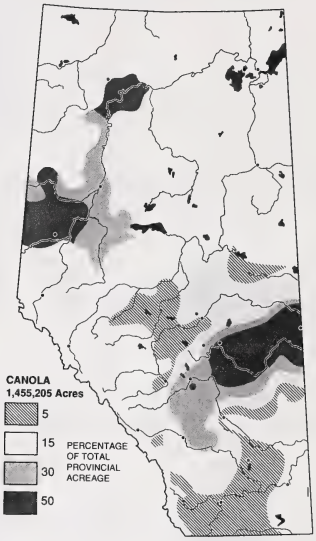
5. List the four steps of the technological problem-solving model.

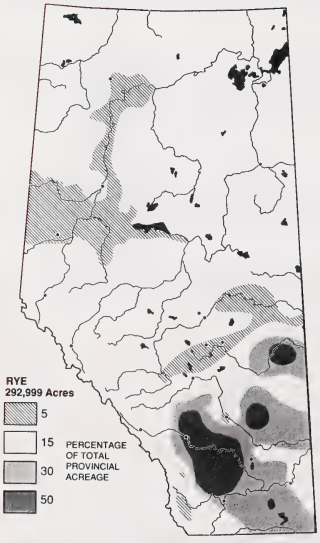
Check your answers with your learning facilitator.

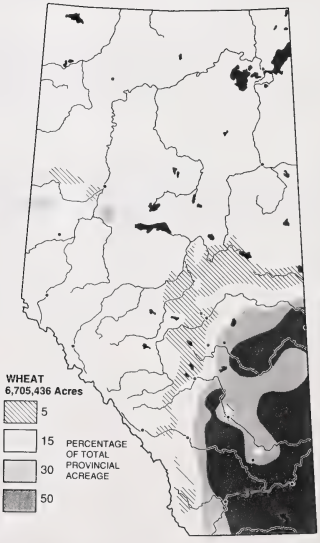
Enrichment

The maps that follow show the main crops grown in Alberta.









1. Using the crop information on the preceding maps, determine Alberta's most important crops. Relate the crop to the number of acres planted in this crop. List them in order of importance, starting with the most important.

_____

_____

_____

_____

_____

_____

2. Make a bar graph based on the information in question 1.

3. What is the main crop in southeastern Alberta?

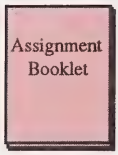
_____

Check your answers with your learning facilitator.

Conclusion

Plants are everywhere. Even if you live in a city you need them on a daily basis to survive. Plants have many structural parts; among them are stems, roots, leaves, flowers, fruits, and buds. Flowers are of special interest because they are involved in reproduction. Flowers consist of sepals, petals, stamens, and pistils.

Plants have a great importance as a food source, and growing them requires a great deal of thought and planning. For farmers and other people applying science, that planning process can be broken down into steps – understanding the problem, developing a plan, carrying out the plan, and evaluating the plan.



ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 1.

Section

2

Plant Growth

Have you ever thought of how plants begin their life? Have you ever watched a plant grow?

There are many similarities between people and plants. Like all living things plants are made of cells. As a plant grows, it makes more and more cells. These cells then form all the parts of that plant. Both people and plants start out small and end up growing bigger.

In Section 1 you might have noticed how much you already knew about plants. In this section you will find out about the life processes in plants. You will discover how plants drink, move, and grow. There will also be problems about growing plants for you to solve.

Activity 1: Germination Rate

Turn to Section 3, Activity 3. Start growing the carrot top or the African violet leaf and stem in the manner described.

Germination: the change from seed to plant

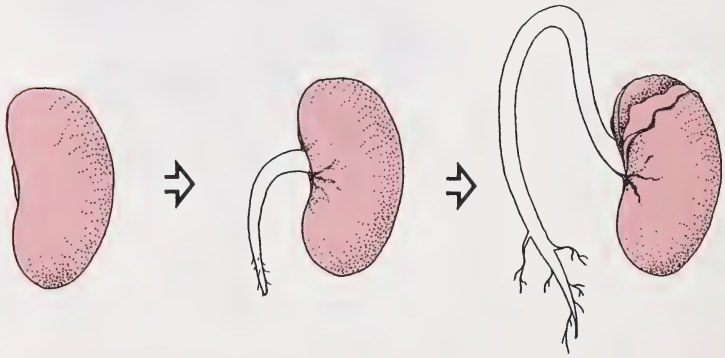
Seed: a small package containing everything needed to start a new plant

Sprout: the first thing that grows out of a seed
It could be either a stem or a root.

The birth of a plant is called **germination**. Germination occurs when a **seed** becomes a **sprout** and then a plant. Seeds may remain seeds for very long periods of time. Archaeologists have found lupin seeds in the Canadian arctic that have been frozen for over 5000 years. After these seeds were thawed out, they grew into normal plants. Just think, the parents of that plant were dead for more than 5000 years.

Seeds will only germinate when the conditions are right. Farmers and gardeners are very interested in finding out the conditions under which the germination rate is the greatest. The germination rate is a percentage and it is calculated like this:

$$\text{Germination rate} = \frac{\text{number of seeds that germinated}}{\text{number of seeds used}} \times 100 \text{ percent}$$



This is a bean germinating.

You are to do a germination study and calculate the germination rates for some seeds in a cool and warm environment.

You will need the following:

- forty radish or bean seeds
- two saucers
- paper towel
- plastic wrap
- one beaker or glass
- soil in which to plant the seedling
- flower pots to hold the planted seedlings – one flower pot at least 15 cm in diameter or a few smaller pots

Do the following:

- Soak the seeds in a beaker or glass of water overnight.
- Cut out pieces of paper towel to fit the saucers. Line the saucers with this towel.
- Put half the seeds in one saucer and half in the other. Space the seeds equally on the towel.
- Record the number of seeds in each saucer.
- Cover the seeds with a paper towel.
- Add just enough water to moisten the towel completely. The seeds should now be sandwiched between two moist layers of towel.
- Cover each saucer with plastic wrap. Fold the wrap around the edges of the saucers.
- Leave one saucer in the fridge and the other somewhere at room temperature. If necessary, add water to keep the towel moist.
- After 4 or 5 days, count the number of seeds that germinated in each saucer. Record this number.
- Plant all the germinated seeds in flower pots. The seedlings are to be kept alive for later use in this module.

Note that you may continue with the activities that follow as you complete this activity.

1. What is the germination rate for the seeds kept in the fridge? Show your calculations.

2. Calculate the germination rate for the seeds kept at room temperature.

3. How does temperature affect the germination rate?

4. Why might it not be an advantage to plant your garden very early in the spring?

5. If you were to plan a garden and you knew how many bean plants you wanted, how would you use what you have learned to help you decide how much seed to buy?

Check your answers with your learning facilitator.

Activity 2: Effects of Nutrients

Have you ever been so thirsty that you thought you must surely be shrinking? Well you probably did not really shrink, but that is exactly what plants do when they are really thirsty. In the diagram of barrel cacti, the cactus on the left has just enjoyed a good rain. The cactus on the right has suffered a long drought.

Plants also need chemicals to grow properly. There are three important nutrients often included in fertilizers. Nitrogen (N) is taken up as nitrates and as ammonia. This occurs naturally when animals die and decay. Nitrogen stimulates the growth of leaves and stems. Phosphorus (P) is used as phosphates, which occur naturally and are formed from decaying organic matter as well. Phosphorus stimulates root growth. The last one is potassium (K); it occurs when plants decay and it is also a mineral in the ground. Potassium stimulates active general growth. Potassium makes the plant larger and encourages fruit to grow.

Read about fertilizers on page 232 in your textbook. See the picture of the bag of fertilizer.

Fertilizer indicates how much of the three nutrients are present by three numbers. For example, the fertilizer shown in the textbook is labelled 10-6-4; that means it has 10 percent nitrogen (N), 6 percent phosphorus (P), 4 percent potassium (K), and the rest is filler.

1. Do Activity 5-7, Comparing the Effects of Nutrients, on page 233 in your textbook. Answer the following.

   Textbook question 1:

   _____

   _____

   _____

8 Science Directions

8 Science Directions

Textbook question 2:

Textbook question 3:

Textbook question 4:

2. A greenhouse owner told you that the tomato plants in her greenhouse had good roots and big stems and leaves, but the plants failed to grow tomatoes. What advice would you give the owner? Why?

Check your answers with your learning facilitator.

Activity 3: Pumping Water with a Plant

Your circulatory system supplies all the cells in your body with nutrients, and it removes the waste products. Plants do not have veins and arteries like you do, yet water has to get to the highest branches in the tallest trees.

1. Hold your arm high above your head. How long can you hold it there? What does it feel like?

_____

_____

Xylem: cells that specialize in conducting water upward

Phloem: cells that specialize in conducting food from the leaves to other parts of the plant

Some of the cells in a plant specialize to form conducting tissues. Cells making up the **xylem** conduct water and minerals upward. Other cells making up the **phloem** carry food made in the leaves downward.

See the stem tissues shown in the photograph and in the diagram on page 241 of your textbook.

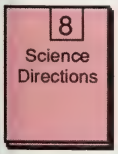
Osmosis: the process by which water and nutrients moves through the cell walls

One of the forces that are responsible for the movement of liquids in a plant is called **osmosis**. Osmosis is at work in both phloem cells and xylem cells. Water will move from a side of the cell that has more water concentration to a side of the cell that has less water concentration.

2. Put a raisin into a glass of water for an hour. In what way does the appearance of the raisin change? Why?

_____

_____



Read How Materials Move In and Out of Plant Cells on pages 222 and 224 of your textbook.

Osmosis occurs when there is more sugar on one side of a cell wall. Water moves from the side that has more water (less sugar) to the side that has less water (more sugar). You can think of it this way – dryness or sugar pulls the water through the plant.

Do either Part A or Part B.

Do Part A if you can obtain glass tubing and a one-hole stopper for the tubing or aquarium tubing and adhesive tape; otherwise do Part B.

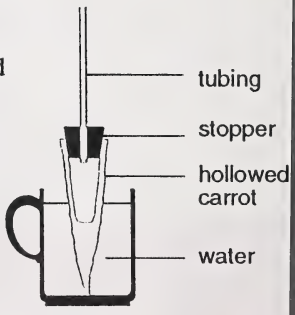
Part A

You'll need the following:

- a large carrot
- one metre of 6-mm glass tubing (aquarium tubing may be used)
- a one-hole stopper for the tubing (adhesive tape may be wrapped around the tubing to form a stopper)
- 50 mL of pancake syrup (corn syrup may be substituted)
- a large cup (or small pot)
- food colouring (optional)

Do the following:

- Make a hole in the carrot. The stopper should fit the hole.
- Put the tubing into the stopper. You may use petroleum jelly to help you.
- Fill up the hollowed carrot with the syrup (and a few drops of food colouring).
- Insert the stopper with the tubing. Make sure a water-tight seal is made.
- Fill the cup with water and place the carrot with the tubing into it.
- Support the tubing so that the carrot and tubing are close to being upright.
- Make several observations of the height of the liquid in the tubing. Observations should be one hour apart. Record your observations.



3. How high did the liquid rise each hour?

4. Did the liquid rise the same amount every hour? Give your thoughts as to why the hourly rise might diminish after a while.

Part B

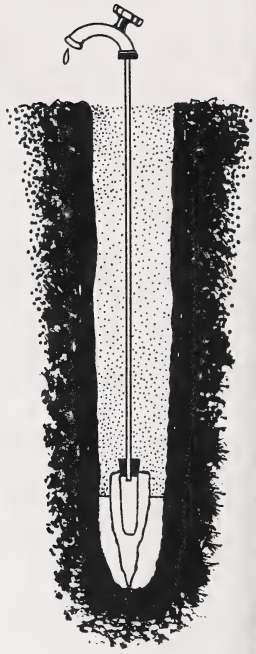
Hollow out a large carrot. Make the hole as large as possible without breaking through to the outside. Place a tablespoon of pancake or corn syrup in the carrot. Place the carrot into a beaker (or cup). Add water to the beaker so that the water level is the same as the syrup level inside the carrot. Leave the carrot in the water overnight. Look at the liquid level in the carrot the next day.

5. What do you notice about the liquid level in the carrot?

6. Do you think that if you kept adding water to the beaker and if the carrot were long enough, the liquid would continue to rise?

End of Part B

7. Do you think a syrup-filled carrot would be useful in bringing up drinking water from a well not operated by electricity?



Check your answers with your learning facilitator.

Activity 4: Transpiration in Celery

1. Think back to a time when you picked some flowers and took them home. What happened if you did not put them into water right away?

Transpiration: the loss of water from the leaves

Osmosis is only one of the forces that are responsible for the movement of liquids in plants. Another one of these forces is **transpiration**. Yes, this word sounds like respiration or perspiration. Transpiration is the loss of water from the leaves. It creates a pull that replaces the lost water with more water from the root.

Now you'll find out more about the movement of water in plants. You'll need one stalk of celery with leaves, two glasses, and red and blue food colouring. Fill the glasses with cold water and add 5 drops of red food colouring to one glass. Add 5 drops of blue food colouring to the other glass. Cut 1 cm off the bottom of the celery stick. Now make a 10-cm slit part way up the middle of the celery stem. In a well-lit area, put the two glasses next to each other and stick one side of the celery in the red water and the other side in the blue water. Wait for several hours.

2. What change do you observe?

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3. Why do you think the leaves were to be kept on the celery?

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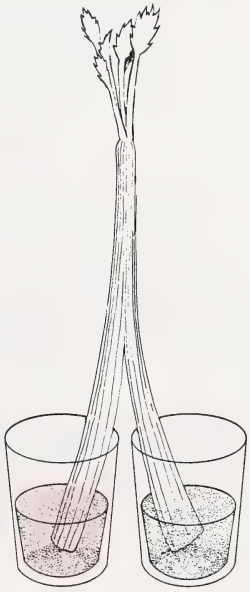

White flowers, such as carnations, can also be dyed by being placed in coloured water.

4. Think of ways that you could use this knowledge. Write down your ideas.

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Check your answers with your learning facilitator.

Activity 5: Plants and Light

Fungus: a simple plant that cannot use sunlight directly

1. Have you ever seen a **fungus**? Describe where.

Very few plants can survive without light. Fungi are one type of plant that can survive. Mushrooms and bread mould are two examples of fungi. They live off dead or decaying things. Some fungi also live off living things. An example is the bracket fungus which grows on trees.

Carbohydrate: a substance made up of carbon, hydrogen, and water

Photosynthesis: the process by which plants use sunlight to make food and oxygen from water and carbon dioxide

However, the large majority of plants need light to survive. Light allows plants to take the most basic materials and manufacture foods that allow them to grow. Plants use carbon dioxide, water, and light to make **carbohydrates** like sugar, starch, and cellulose (paper). In doing so, plants manufacture oxygen. This process is called **photosynthesis**.

Read about photosynthesis on page 220 of your textbook. Also look at the textbook diagram on page 247.

2. Give a word equation to represent photosynthesis.

3. Tell how the word *photosynthesis* is derived from the Greek language.

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4. From where does the plant obtain the carbon dioxide it uses?

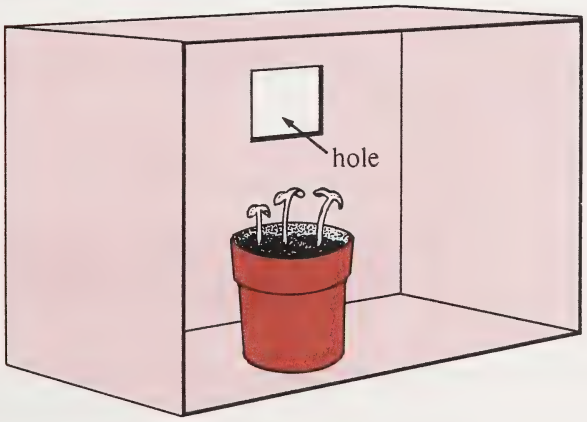
_____

5. Which plant structure is most important for food production?

_____

The carbohydrates produced by plants provide all the energy for every animal on Earth – from the field mouse and the rabbit to the eagle and the wolf. When they die they provide more nutrients for more plants. All this begins with sunlight.

Note that you may continue with the activities that follow, as you finish this activity.



Plants sometimes grow in a curious way in order to obtain the light they need so badly. To find out how, take six of your seedlings from Activity 1. You may have to transplant them. Put three of them near a window. Put the other three into a 30 cm × 30 cm × 30 cm box that has a 5 cm × 5 cm hole cut into the side. (The box can be made from cereal box cardboard. The size does not have to be exactly as indicated.) Place the box near the same window. Now all your plants are near the window, but half of them are in the box. Allow the plants to grow and observe them over four days. Look at the plants at the following times: after half a day, after a day, after a day and a half, after two days, and after four days of growth.

6. Compare the growth of the plants in the box with those not in the box.

7. Which plant grew faster? Which one was greener?

8. How would this help you decide whether plants are getting enough light?

Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

Here is a review of the basic ideas in this section.

- Growing plants have several needs. Among them are warmth, water, and light.
- Plants start small and grow larger with age.
- The process in which seeds turn into plants is called germination.
- Seeds can be dormant for many years.
- The percentage of seeds that germinate is called the germination rate.
- Seeds need warmth and water to germinate.
- Plants need nitrogen, phosphorus, and potassium to grow.
- Nitrogen stimulates the growth of leaves and stems.
- Phosphorus stimulates root growth.
- Potassium makes the whole plant grow to a full size and encourages the growing of fruit.
- Phloem cells conduct the food made in the leaves to other parts of the plant.

- Xylem cells conduct water and nutrients from the roots of the leaves.
- Water moves through a cell membrane from higher water to lower water concentration by osmosis.
- Transpiration is the loss of water from leaves. Transpiration pulls the water up from the roots.
- Plants need light to grow. If the light is limited and from only one direction, the plants will grow very quickly toward the light source.

1. List two ways in which plants are like people.

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2. What does nitrogen do for a plant?

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3. If just after planting everything was fine with a plant except that the roots were too small, what would be missing?

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4. Explain how transpiration is involved in colouring a white flower blue.

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Check your answers with your learning facilitator.

Enrichment

There are many products available to help you to grow plants indoors. Visit your local hardware store, plant nursery, or department store garden centre to find out what these products are. Report your findings.

Share your answers with your learning facilitator.

Conclusion

You have learned that plants are made of many cells. Just like you, plants need warmth and water to live. However, plants make their own food using light. In the absence of sufficient light, plants respond by speeding up their growth. If there are not enough nutrients in the soil, plants will let you know what is missing by growing in different ways. With all this knowledge you are now able to germinate seeds and grow them into plants. You will be able to tell what your plants need, and you'll be able to give them proper care.

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 2.

Section

3

Plant Propagation

Do plants date? Do they get married? Do they raise their children? Even though you cannot be completely sure that plants do not have feelings and maybe even feeling for each other, you are quite certain that their feelings do not make them behave quite like people.

When it comes to propagation, or in other words to have offspring, plants are sometimes very much like people and at other times completely different. And, yes, some plants even raise their children; in a manner of speaking.

In this section you will learn how to propagate plants in a number of different ways. You will also look at changing plants through propagation.

Activity 1: Find the Seed

Have you eaten an apple today? How about an orange, a grape, or maybe a guava? Did you have beans, peas, or a tomato? If you had any of these you have eaten the fruit of a plant. That's right, beans, tomatoes, and many other vegetables are fruits. You can tell they are fruits because somewhere in fruit there are seeds.

1. Think of as many fruits as you can. Name several of these fruits and describe the seeds briefly.
   (for example: tomato – many seeds the size of a pinhead)

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The most common method of propagating crop plants is through seeds. Seeds are the children of the plants. Think back to the parts of the flower. Seeds are produced after pollen is carried from the stamens of one plant to the pistils of another plant. After that, the ovary grows into a seed. You can write this to look like a math equation:

Pollen (father) + Ovary (mother) = Seed (child)

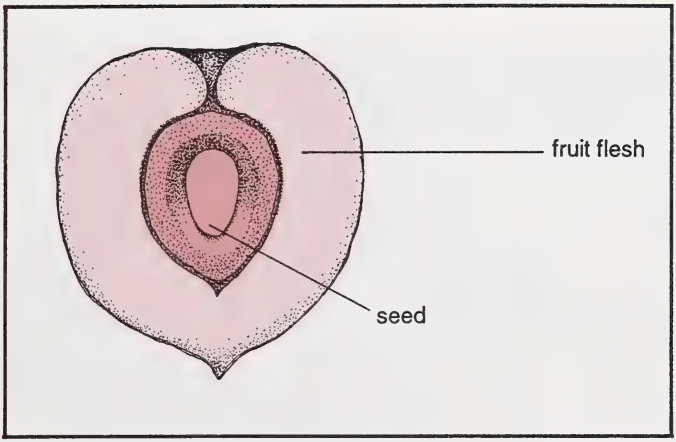
Pollination: the transfer of pollen from the anther to the stigma resulting in fertilization

Sexual reproduction: reproduction that involves both female and male structures

Fruit flesh: the thick vitamin-rich and water-rich outer covering of many seeds

The transfer of pollen is called **pollination** and this is the way plants reproduce **sexually**. Often plants grow seeds that are surrounded by **fruit flesh**. This is the delicious part that people eat while the seeds are often thrown away. This is exactly what the plant has planned of course. If you eat every part of your apple you are eating the plant's children. However, if you throw the apple core outside and the right conditions for sprouting and growing exist, an apple tree will take root. If you throw the whole apple away, the fruit flesh may provide extra moisture and nutrition for the seed. That helps the plant too.

2. List five more plants not listed in question 1 that have seeds surrounded by fruit flesh.



Many berries rely on birds to eat them to be propagated. The berries feed the bird, but the seeds have a special tough coating on them and pass right through the bird and then fall on the ground to grow into another plant. There are some plants that need to pass through an animal intestine to be able to grow because they are surrounded by such a tough outer coating that it takes the strong stomach acids to remove coating.

3. Think of three plants that propagate by having their seed pass through the digestive track of a creature. Write their names.

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4. In Canada's north one can often find raspberries growing where people live. Sometimes the outhouses are completely surrounded by beautiful raspberry bushes. Using what you have learned, explain how this can occur.

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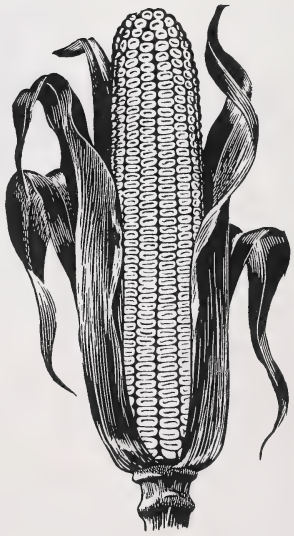
Check your answers with your learning facilitator.

There is one kind of seed that is valuable to people. Many of the grasses produce large numbers of seeds in structures called **ears**. The seeds are small packages that are very nutritious; they contain high-quality carbohydrates, proteins, minerals, and vitamins. In Alberta quite a bit of wheat and barley is grown. This is made into flour or animal fodder, or it is exported.

Ears: a seed-bearing structure like a corn cob



Activity 2: The Plant and the Pollinator

Have you ever been rewarded for doing something helpful or nice for someone else? Well, there are many examples of plants and animals having a relationship that is rewarding for both parties.

You learned that flowers are used to signal to insects or birds that the plant is ready to reproduce. Honey that bees collect from many flowers is made from nectar – a sweet, fragrant liquid that the plant secretes in the flower. While the bees collect the pollen, they carry the pollen between the flowers. Any animal that carries pollen from one flower to another is called a **pollinator**.

Pollinator: an organism that pollinates plants by carrying pollen

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Many pollinators, like bees, wasps, moths, birds, and bats, prefer flowers with a fragrance or a particular colour, and so they will carry the pollen from these flowers more often to other flowers with the same appealing characteristic. Pollinators are often equipped with special mouth parts to get at the nectar. Some flowers have changed over many thousands of years to have special shapes that only particular animals can get at. Some plants try to annoy some insects; when the insect attacks the flower, they are pollinating it. Some orchids use strategies like these to ensure that they are pollinated.

1. Match the flower with the likely pollinator.

   (1) Bees, which like bright flowers

   (2) Hummingbirds, which have long, thin beaks and can hover near a flower

   (3) Butterflies, which have long, thin tongues and can sit on a flower

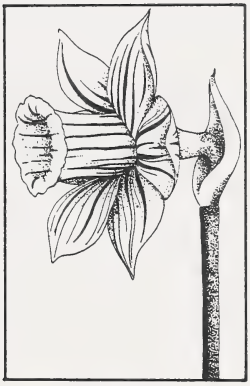
   (4) Wasps, which are very aggressive even towards other wasps

   (5) Flies, which like the stink of rotting things

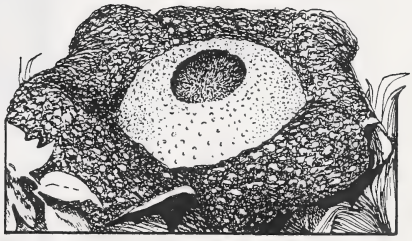
_____ a. dandelion

_____ b. fuchsia

_____ c. daffodil having wasp-like stripes



_____ d. rafflesia, which smells like dead things



Check your answers by turning to the Appendix, Section 3: Activity 2.

People have tried pollinating plants for a long time. Corn was originally bred from a plant that looked like grass. The pollen from the plants with the largest seeds were used to fertilize another plant with large seeds and the new plant would have larger seeds. Another example is the banana which was bred to have no seeds. This means that it cannot reproduce through its fruits. These are examples of the application of artifical pollination.

2. Can you think of any other appealing characteristics that you would like to breed into some of your favourite plants?

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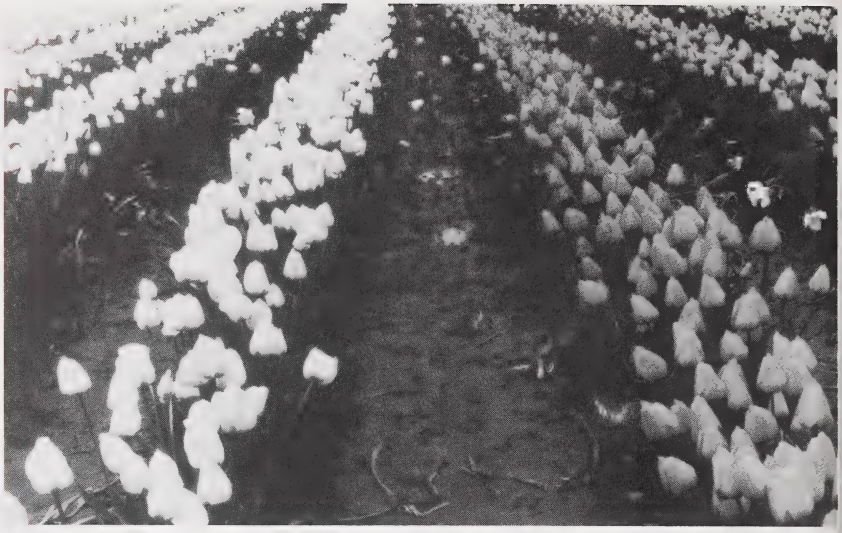

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In the Netherlands, an entire industry is based on the breeding and growing of tulips. Every year there are auctions where the best and the newest tulips are sold for large sums of money. In England, people have bred roses for many generations with very colourful results. Breeding plants is a very inexpensive and fun hobby. All you need to start are a few very simple tools, a small brush to pick up pollen from one plant and put it onto another, tweezers to carefully open some complicated flowers and get at the stamen or the pistil, a notebook to keep track of which plant you pollinated, and some tags to identify the plants.

3. a. Which country is known for breeding roses?

_____

b. Which country is known for breeding tulips?

_____

Check your answers with your learning facilitator.

Activity 3: Growing Plant Parts

Have you ever hurt yourself? Have you ever had deep frostbite on the tip of your nose or a fingertip and found that the affected parts grew back again?

1. What do you think is the largest part of your body that you can regrow?

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Plants are capable of growing entire plants back from very small pieces of the original plant. That's right, you can pull a plant out of the ground and take a small portion of it and plant it. After it grows into a full-grown plant you can pull it out again, eat most of it, plant a small part of the plant, let it grow, and so on. The secret is in knowing which part to plant.

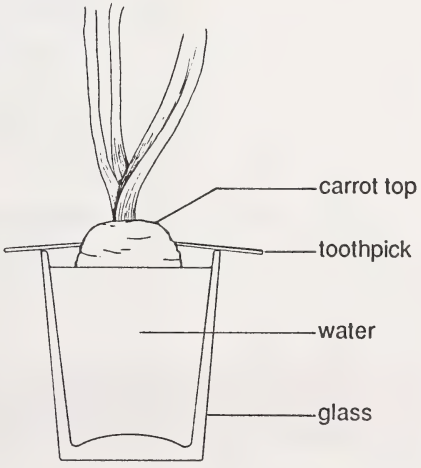
Note that you may continue with the activities that follow as you finish this activity.

Do either Part A or Part B.

Part A requires you to obtain a carrot plant that has the top leaves. Part B requires you to obtain from an African violet a leaf with its stem attached.

Part A

You need to find a carrot plant that still has the top leaves or at least part of them. Cut most of the root off, leaving about a centimetre attached to the leaves. Stick three or four toothpicks into the sides and put the carrot on top of a glass of water so that the bottom just touches the water. See the diagram. Leave the carrot suspended over the water for at least a week. Then answer the following question.



2. Which part of the carrot did the plant grow back?

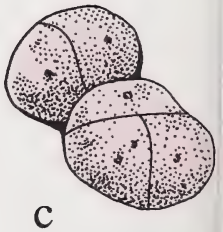
Part B

Fill a cottage cheese container or a similar container with water. Puncture a small hole through the lid of the container and close the container with this lid. Remove a leaf with its stem attached from an African violet. Push the stem through the opening in the lid. The leaf should be exposed to light above the lid and the end of the stem should be in the water. Leave the leaf and stem above the water for at least a week. Then remove the lid to look at the stem.

3. What part of the African violet developed after the leaf and stem were taken from the original African violet plant?

End of Part B

Many farmers in Alberta grow potatoes, but they do not grow them for food. These are special potatoes; they are exported as seed potatoes to places like Idaho, USA. Idaho is famous for its potatoes. The seed potatoes come from Alberta because Alberta is free of certain diseases. A potato plant can be grown from just a small part of a potato – as long as the part contains an eye. The parts of the potato plant that you normally eat are not the roots. They are a special kind of stem called tubers.



C

New plants can be grown from parts of each of the plants listed. Try to grow some; it's fun.

- Dandelion – will grow even from the smallest piece of root
- Begonia – can be grown from a piece of the leaf (this must have a vein in it)
- Sanseveria (snakeplant) – can be grown from a slice of the leaf
- Diefenbachia – can be grown from a piece of the stem that has one leaf on it

Tradescantia cuttings growing roots in water

There are many other plants as well.

In each case the part has only to be put into water, or into moist soil that contains some fertilizer, to stimulate root growth.

4. If you grew a potato plant from only one of the eyes, which parts of the plant would the potato grow back?

_____

_____

_____

_____

5. To whom would this knowledge be valuable? Why?

_____

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Check your answers with your learning facilitator.

Activity 4: Growing Plants from Stems

Do you have a twin brother or sister? Maybe you are one of the many people who have wondered what that would be like. Identical twins are physically completely the same because they started out with the same genetic information in their cells.

1. Can you think of one reason why it would be fascinating to have another you?

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_____

Many plants and even some animals can reproduce by splitting a part of themselves off. This part will grow into an exact copy. This does not mean that every branch and every leaf will be in exactly the same place, but the colour of the plant's flowers, the scent of the nectar, and the size of the fruit would be the same (given the same environment). This splitting is one method of **asexual reproduction**. You already learned about an example of asexual reproduction that involved cuttings.

Asexual reproduction: reproduction that does not involve male and female structures

On their own, poplar trees, raspberries, quack grass, and lilacs grow roots that creep away from the tree and then turn up in other locations. Then the root becomes a stem which grows branches and leaves. These are called **sucker** shoots and in time they would be fully grown trees. Suckers are grown in spring and they can become a real problem for gardeners. Strawberries grow special stems called **runners**. The stem grows away from the plant and when it hits fertile ground it grows little roots and leaves and it becomes an identical strawberry plant.

Sucker: a root that will become another plant

Runner: a special stem that becomes another plant

Many bushes like gooseberries and currants will grow branches very low to the ground. As these branches touch the ground they will develop roots.

2. Go outside and look for one of the previously described plants. Can you find evidence of sucker shoots or runners anywhere? If not, ask your facilitator for information.
   Hint: You may have to look for last year's growths. Describe the pattern they form with the parent plant.

_____

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_____

3. How could sucker shoots become a problem for a gardener? How could they become a problem for the plant?

Check your answers with your learning facilitator.

Activity 5: Grafting Plants

Grafting is to plants what organ transplants are to people.

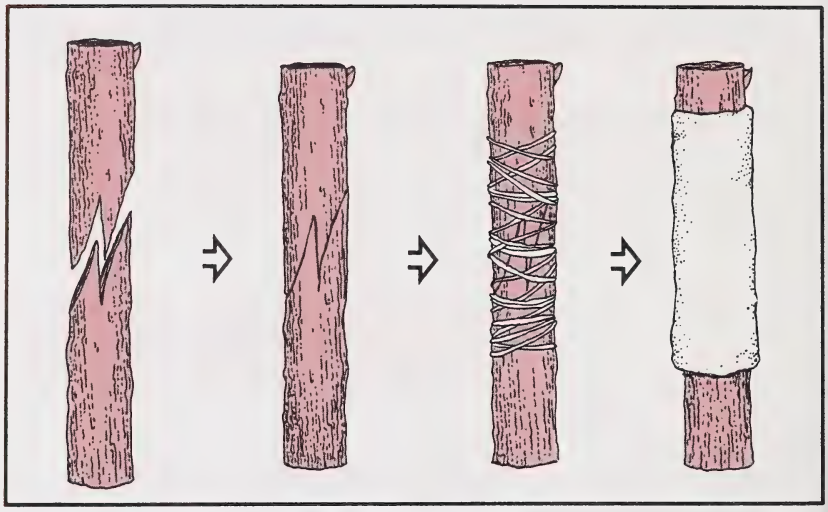
1. What kind of organs have you heard of that are being transplanted into people?

In humans the reason for a transplant is often to save a life or to make a normal life possible. In plants transplants are done for a different reason. Grafting is used almost exclusively with fruit trees like apples, pears, and peaches, and some ornamental plants like roses and lilacs. Grafting is another method of asexual reproduction.

To graft a tree, a small shoot or the growing tip of the branch of a particularly desirable fruit tree is stuck onto a less desirable tree. From then on, that branch will grow the desirable fruit while the rest of the tree grows the less desirable fruit.

Read about grafting on page 259 of your textbook.

The diagram shows a method for putting branches together. The cuts need to match well and then they need to be bandaged and sealed with a wound dressing to keep germs out.



2. Why is grafting used to make new plants?

When a tree is grafted, the root is often the root of a very hardy tree like a crabapple, and everything from the trunk up becomes the new variety. Sometimes several different kinds of apple can be grown on one tree. It has even been possible to mix quite different fruits on one tree by careful grafting.

Grafting has some drawbacks. Grafting requires more time than making a cutting. Grafting is also often unsuccessful because of the difficulty in making the cuts match well.

3. Describe an imaginary tree that bears all of your favourite fruits. Can you think of an advantage in having a variety of fruit on just one tree.

_____

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Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

Here is a review of the basic ideas in this section.

- Plants grow from seeds.
- Seeds are the children of plants.
- Seeds are often surrounded by extra plant tissue called fruit flesh.
- Fruit flesh serves several functions: one function is to fertilize, another function is to persuade animals to eat the fruit and then carry the seed far and wide.
- Fruits are the result of pollination. For many flowering plants, pollination is done by animals or insects.
- Plants have adapted to specific pollinators.
- Pollination is a part of sexual reproduction. Such reproduction requires both male and female plant cells.

- Plants can be grown from stems, roots, or leaves. This is called asexual reproduction. In this type of reproduction the new plant is the same as the original plant.

- Parts of plants can be transplanted onto other plants by means of grafting. Grafting allows important plant characteristics to be retained.

1. How are seeds produced?

2. Name several plant parts that can be grown into full plants.

3. What is a general name for the type of reproduction that involves growing complete plants from a part of the root, stem, or leaf?

4. Describe the role a bee plays in the reproduction of plants.

5. Compare how the seeds of a dandelion and the seeds of a raspberry are distributed.

Check your answers with your learning facilitator.

Enrichment

Imagine that you made your living by picking blueberries. Year after year the blueberries have been there. The old plants have died and new plants were seeded from the berries that the birds had eaten. Ever since your neighbours started to clear the land around your place the birds have become fewer and fewer and so have the blueberries. Your immediate worry is the blueberries. How could you increase the number of blueberry bushes. You cannot afford to buy them, but you have saved quite a few of the seeds. The only problem is that they just will not germinate.

1. Develop two different plans to make the blueberry seeds germinate.

2. What choices would be left to you if all your efforts in sprouting the seeds did not pay off?

_____

_____

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Check your answers with your learning facilitator.

Conclusion

Plants propagate in a variety of ways, whether that is through sexual or asexual reproduction. This variety ensures the success of the plant in many circumstances. In many cases the way in which seeds are constructed helps to increase the area that they are distributed over. Plants have established adaptive relationships with other organisms. These are often based on mutual benefit.

Over many thousands of years people have learned to manipulate plant reproduction for their own benefit. This has resulted in many new varieties of plants. Some are ornamental, like flowers; others are food plants. Plants have been selected to be larger, more nutritious, tastier, more colourful, or more resistant to disease and temperature extremes than naturally occurring species.

All that has been learned about plants allows farmers and gardeners to solve problems so that everyone benefits.

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 3.

Section

4

Growing Plants: Problems and Solutions

You may have seen newspaper headlines that tell of a direct impact on plants and an indirect impact on human beings.

As the world population of the Earth increases, there is a greater and greater demand for food plants. People are looking for new varieties of plants that are more pest and disease resistant, that yield more food, and that grow in drier or colder climates.

In this section you will be learning about techniques for preparing soil, learning about pests and diseases that affect plants, and designing a plant study.

Activity 1: Soil and Plant Nutrition

Have you ever been scolded for getting dirty or for bringing dirt into the house? Perhaps someone else was responsible for the muddy tracks on the floor?

When soil is brought into your house it is thought of as dirt. Dirt may not be the most desirable thing in the house but is it very important for the well-being of plants.

1. Think back to what you have learned, and list some of the things that make soil important to plants.

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In Alberta there are various types of soils. All of these soil types are made up of varying amounts of three things: inorganic material, organic material, and pore space.

Inorganic material consists of particles that come from the weathering of rock. These particles make up 90 to 99 percent of the solid part of most soil types. It is the source of minerals that the plant needs to survive. It provides calcium, iron, and magnesium.

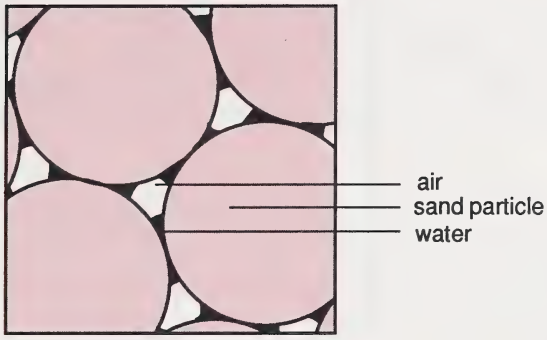
Organic material comes from any living thing. Organic material is rich in potassium, phosphorus, and nitrogen, which are also needed by plants and in large amounts. (The nutrients potassium, phosphorus, and nitrogen are the main nutrients found in fertilizers.) The roots of the plant also need air in addition to water, and that is what is found in the pore space.

Soil texture is a term used to refer to the size of the inorganic particles of soil. Soil in which the rock particles are very fine is called clay soil. Soil in which the rock particles are moderately fine is silt soil. Sandy soil has relatively large rock particles. The amount of water and air a soil can hold is related to the soil's texture. You can see how texture affects a soil's ability to hold water and air by looking at magnified illustrations of the soil components **sand**, **silt**, and **clay**.

Sand: coarsely broken particles of rock abnout 0.2 mm in diameter

Silt: fine particles of rock about 0.02 mm in diameter

Clay: very fine particles of rock about 0.002 mm in diameter

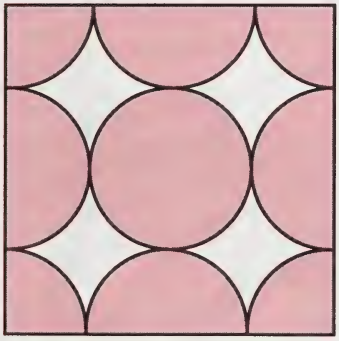


Sand

In the picture of sand the particles are shown as large circles and the water as black shading. The shading occurs where the circles are close together. The white (unshaded) region between the circles represents air.

2. Complete the pictures of silt and clay by showing the water and air. Label your completed diagrams.

These drawings are not to scale.



Silt

Clay

3. Comment on the amount of air and water in the three soils.

4. How well do you think gravel will retain water? Give reasons for your answer.

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Farmers control the soil characteristics in a variety of ways:

The first way is by plowing. This turns the soil over and allows air to penetrate deeper down. However, this also makes soil more vulnerable to erosion by wind or water. Erosion by water is often prevented by **terracing** the land. In China, rice fields are terraced, and in mountainous countries, fields on the steep slopes are terraced. To prevent wind erosion, windblocks like fences, hedges, or lines of trees are often put up. Wind erosion is a serious problem in southern Alberta, Saskatchewan, and Manitoba.

Terracing: changing the slope of a hill into steps that are level

The second way to control soil characteristics is by adding nutrients to the soil; a chemical fertilizer, **humus**, or **manure** can be applied.

Humus: rotten plant material

Manure: animal waste or dung

Humus is rotting vegetation, and manure is basically sewage from humans or animals. Fertilizing is often followed by plowing. Some farmers change crops every year because each plant removes different nutrients from the soil. By growing a crop of alfalfa, beans, peas, or lupins, farmers restore the soil through the nitrogen-fixing ability of these **legumes**. Legumes convert gaseous nitrogen from the air into a form that can remain in the soil.

Legumes: the group of plants to which peas, beans, and alfalfa belong

The third way to control soil characteristics is by changing the average particle size of the soil. Because of the cost, this is usually not something a farmer changes. Large amounts of sand or clay have to be added to make a difference. Gardeners and greenhouse owners sometimes add sand to soil that has too much clay.

5. Suppose that you are a farmer and a good part of your land is bare sand with hardly a thing growing on it. Most of your income comes from raising pigs, but you would really like to be able to use that sandy spot for growing some of the food the pigs are eating. Develop a plan to make that sandy spot into usable soil. Try to think of ways other than buying soil and trucking it in.

Read pages 229 and 230 in your textbook.

6. Why is peat moss added to soil?

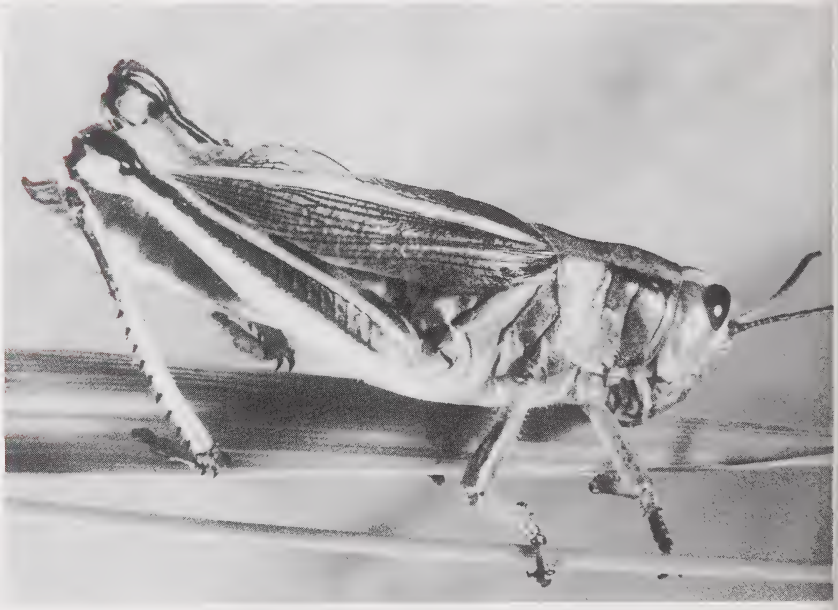
7. What is the purpose of adding vermiculite or perlite to soil?

Check your answers with your learning facilitator.

Activity 2: Pests and Diseases

Remember the last time you had a cold how weak and irritable you felt? Imagine being pestered by a swarm of mosquitoes at the same time and having to do your homework on top.

Plants are prey to many different pests. Most of them are called bugs by people, but not all bugs are pests. Like people, plants have immune systems that deal with many diseases and pests, and so they can live through many of these attacks. Diseases can be caused by viruses, bacteria, or fungi and when several of these attack a plant the natural defenses of the plant may break down. You could imagine a plant feeling a bit like you did when you were sick.



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Swarms of grasshoppers are a periodic problem on the Canadian prairies. But not all bugs are bad. In a way, the method of planting the same crop in large areas has allowed epidemics to develop. Once an insect has found a good crop, it can just eat and multiply. Farmers would usually spray on **insecticide** in that case. Releasing large numbers of ladybird beetles (lady bugs) to feed on aphids and caterpillars is another solution. Other predators of pests are birds, frogs, spiders, ichneumon wasps, lacewing flies, dragonflies, and caterpillar hunters.

Insecticide: a chemical that kills insects

A caterpillar hunter is carrying a caterpillar to its burrow for a family meal.

Read Alternatives to Pesticides in your textbook on pages 266 and 267.

1. In biological controls, what is used instead of human-made chemicals to control plant pests.

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2. Give an example of a biological control used by plant growers.

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Some plants produce substances that act as repellants. Chrysanthemums contain chemicals that many insects cannot stand. Garlic and onions repel caterpillars that often harm cabbages. By planting certain crops together, gardeners can do without pesticides.

Infrared light: light that is not visible but is felt as warmth by the skin

Today satellite images can be used to identify crop diseases from photographs taken with **infrared light**. Depending on what colour you see on the photo you can tell what is wrong with your crop. Farmers are beginning to use computers to help manage their crops.

Plants have been bred for certain desirable qualities, such as high yield; however, in the process other qualities have been lost. Crops have become less disease-resistant and pest-resistant through breeding. Agriculturalists are trying to back-breed some of the hardy, disease-resistant qualities back into the crops. There are now banks of seeds that keep old original varieties of crop seeds for breeding. It is now realized that there was something very valuable in the way some old varieties had adapted to deal with pests and diseases.

The buildup of herbicides and pesticides over the last 40 years has concerned many people because several bird species have been brought to extinction by this buildup. The chemicals have also caused many illnesses in people through overuse and carelessness. These factors have spurred people on to look for alternative methods of controlling plant pests and diseases.

8 Science Directions

Read pages 260 and 261 in your textbook to find out how to deal with plant problems. Become familiar with the diagnosis chart on pages 262 to 265. Use this chart in the diagnosis you do in the questions that follow.

Use the chart to determine what is wrong with a plant that has green leaves and looks like it is generally in good health but has coloured spots on its leaves. Follow the arrows pointing right from symptoms 1 and 2. At symptom 3 your response is *yes*, so follow the arrow going down. You can conclude that the spots are possibly due to a viral infection.

Notice the use of the words *symptom* and *diagnosis* in the chart. When you detect a symptom you are making an observation. A diagnosis, on the other hand, is an inference made on the basis of your observation.

3. Now use the chart in a reverse fashion. What would be some symptoms in a plant that had been given too much water or too little water over a period of time.

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8 Science Directions

4. Do question 6 on page 269 of your textbook.

   Textbook question 6. (a):

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   Textbook question 6. (b):

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Textbook question 6. (c):

Textbook question 6. (d):

5. Do question 8 on page 269 of your textbook.

A single symptom may not be enough to make a reliable diagnosis. For example, a plant having slightly droopy leaves may be due to the soil being too dry or wet or to the presence of bugs on the plant. Usually a number of observations are needed to make a precise diagnosis.

6. If you can obtain an unhealthy plant to look at, tell what you would do to help the plant recover. Indicate how you used the diagnosis chart to arrive at your recommended treatment.

Check your answers with your learning facilitator.

Activity 3: Plant Study – Comparative Growth

Now you will apply everything you have learned about plants to investigate the effect of one factor on plant growth. The plants you will use are the ones you saved from the germination study in Section 2, Activity 1.

You will use science inquiry skills in your investigation. Choose one thing that you wish to change for your plants. You could alter the intensity of the light, the colour of the light, the amount of fertilizer, the kind of soil, or something else that you would like to find out about; but do not change more than one variable.

Divide your plants into at least two groups in such a manner that each group does not differ too much from the others. Be prepared for an investigation that will take a number of days to complete. In the meantime, you may continue with this module and start the next one.

Step 1: Questioning

1. What question do you want answered by your investigation?

Step 2: Proposing Ideas

2. What is your hypothesis?

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Step 3: Designing Experiments

The responding variable in your investigation is likely plant height or the change in plant height. The manipulated variable is the factor you change in order to study its effect.

3. What is the manipulated variable in your investigation?

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4. What procedure will you be following?

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Check your answers with your learning facilitator.

Do question 5 as you follow your procedure.

Steps 4 and 5: Gathering and Processing Data

5. Record your observations. You may use a chart or a graph to present your data.

Step 6: Interpreting Data

6. What conclusion can you make to answer the question you started out with?

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Check your answers with your learning facilitator.

Follow-up Activities

If you had difficulties understanding the concepts in the activities, it is recommended that you do the Extra Help. If you have a clear understanding of the concepts, it is recommended that you do the Enrichment.

Extra Help

Here is a review of the basic ideas in this section.

- Soil is important to the well-being of a plant.
- Inorganic material, organic material, and pore space make up the soil.
- Inorganic material comes from the weathering of rocks, and it provides minerals, e.g., calcium, iron, and magnesium, for plant growth.
- Organic material comes from dead plants and animals, and it provides important nutrients like nitrogen, phosphorus, and potassium.
- The size of the particles in the soil determines how much air and water the soil can hold.
- Sandy soil has fairly large particles and it holds more air than water.
- Silt soil has smaller particles and it holds about equal amounts of air and water.
- Clay soil has the smallest particles and it holds very little air and mostly water.
- Plowing is an important method of preparing the soil and mixing it with more nutrients.
- Plowing the soil makes it more vulnerable to erosion by wind and water.
- Terracing and windblocks are used to prevent erosion.
- Legumes like peas, beans, alfalfa, and lupins enrich the soil with nitrogen.
- Soils can be enriched by adding humus, manure, or chemical fertilizers.
- Plants are harmed by many pests and diseases.
- A plant pest is a usually a small bug, worm, or insect.

- A plant disease is caused by viruses, bacteria, or fungi.
- Breeding has made many crop plants less resistant to pests and diseases.
- Planting the same crop over a large area allows large numbers of pests to become established.
- Pesticides have some benficial effects on plants and some harmful effects on people and the environment.
- Some insects, birds, and frogs are very effective at controlling pests.

1. Name three soils based on the size of the soil particle in them.

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2. What relationship do the soils have to the amount of water and air held by them?

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3. Name two ways in which soils can be enriched.

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4. What does terracing prevent?

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5. How does varying the crops affect the spread of pests?

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6. How do ladybird beetles affect plants?

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7. How do you tell if a plant has a pest or is diseased?

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Check your answers with your learning facilitator.

Enrichment

Read page 346 in your textbook to find out the location and role of genes in living cells.

By combining the genes of widely different living things in a process called gene-splicing, plants can be made to produce products that would be very costly to produce in laboratories. Living plants can be made to produce proteins that are normally found almost exclusively in animals, drugs to treat diseases, and oils to lubricate and fuel machines. In one case, a plant's genetic material was changed so that the plant produced the chemical that makes glowworms glow. This plant now emits an eerie green light which can be seen during the night.

Think of a number of reasons why it would be an advantage to have plants perform functions like the ones mentioned. Consider the impact on the environment of plants performing those new functions.

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Share your answers with your learning facilitator.

Conclusion

Soil types affect the growth of plants in several ways. The amount of minerals from inorganic material, the amount of nutrients from organic material, and the pore space determine how good the soil is for the plants. Soil erosion is a problem as soon as the soil is in any way disturbed. Terracing and windblocks are two ways in which this is prevented.

Plants are also prey to many pests and diseases. There are several ways in which to deal with these. Some involve the use of other animals or plants, others involve the use of chemicals. There are costs and benefits to either way of dealing with pests and diseases.

There are many things that are being discovered only as you are reading this. By using the skills of the scientist you too can find solutions to many of today's plant problems.

Assignment Booklet

ASSIGNMENT

Turn to your Assignment Booklet and do the assignment for Section 4.

MODULE SUMMARY

Plants are the basis of all life on Earth. It is through plants that sunlight turns the elements found on the Earth into food that animals and people can eat.

Plants come in a wide variety of shapes and sizes. They share many common structures and differ in as many others. The similarities and differences between plants are often adaptations to special environments. People try to make use of these by breeding plants for food and other uses.

Plants have very specific requirements for growth. Next to water, warmth, air, and light, they need essential nutrients and minerals to grow properly. Plants propagate in many ways – some sexually and others asexually. They do so by cooperating with other living things in their environment. Over long periods of time, plants have adapted to the most extreme locations on Earth.

Over many thousands of years people have learned a great deal about plants. But there is much left to discover. By looking around and investigating, scientists are providing more information to enable farmers and gardeners to meet the demand of an ever-increasing world population.

Appendix

Glossary

Anther
- the tip of the stamen
  It produces pollen.

Asexual reproduction
- reproduction that does not involve male and female structures

Carbohydrate
- a substance made up of carbon, hydrogen, and water

Clay
- very fine particles of rock about 0.002 mm in diameter

Ears
- a seed-bearing structure like a corn cob

Fruit flesh
- the thick vitamin and water rich covering of many seeds

Fungus
- a simple plant that cannot use sunlight to make its own food

Germination
- the change from seed to plant

Humus
- rotten plant material

Infrared light
- light that is not visible but is felt as warmth by the skin

Insecticide
- a chemical that kills insects

Legumes
- the group of plants to which peas, beans, and alfalfa belong

Manure
- animal waste or dung

Osmosis
- the process by which water and nutrients move through the cell wall

Ovary
- the enlarged part of the pistil which contains the female genetic material of plants

Petal
- one of the coloured parts of the flower

Phloem
- cells that specialize in conducting food from the leaves to other parts of the plant

Photosynthesis
- the process by which plants use sunlight to make food and oxygen from water and carbon dioxide

Pistil
- the female part of the flower
  It contains the ovary.

Pollen	• the fine, yellowish powder formed at the top of the stamen This powder contains the male genetic material of plants.
Pollination	• the transfer of pollen from the anther to the stigma resulting in fertilization
Pollinator	• an organism that carries pollen from anthers to stigmas
Root	• the part of the plant that grows down, usually underground
Runner	• a special stem that becomes another plant
Sand	• coarsely broken particles of rock about 0.2 mm in diameter
Seed	• a small package containing everything needed to start a new plant
Sepal	• one of the leaves that form the outer covering of the flower
Sexual reproduction	• reproduction that involves male and female structures
Silt	• fine particles of rock about 0.02 mm in diameter
Sprout	• the first growth out of a germinating seed It could be either the beginning of a stem or a root.
Stamen	• the male part of the flower
Sucker	• a root that will become another plant
Terracing	• changing the slope of a hill into steps that are level
Transpiration	• the loss of water from leaves
Xylem	• cells that specialize in conducting water upwards in a plant

Suggested Answers

Section 3: Activity 2

1. (1) a.

   (2) (3) b.

   (4) c.

   (5) d.

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